

Silvio Marti

Student	Silvio Marti
Examiner	Prof. Dr. Heinz Mathis
Subject Area	Sensor, Actuator and Communication Systems

3D Indoor Localization System for Light Shows with Drones

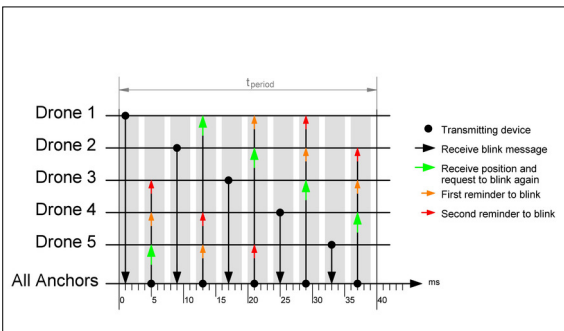


The final rehearsal for DJ Bobo's "Kaleidoluna" show.
Source: MOJO Devices

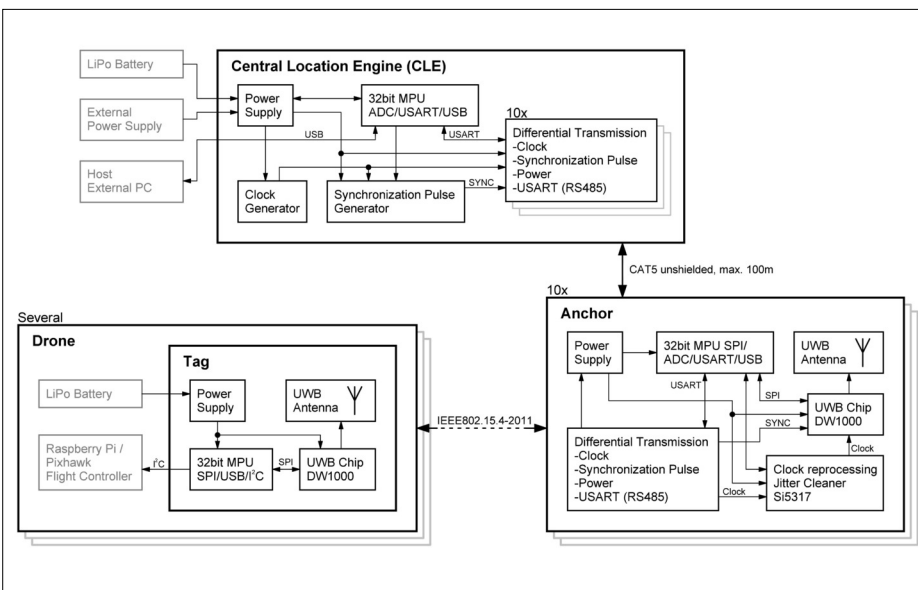
Introduction: Many show events use fireworks for light effects. The technological progress and the availability of highly accurate indoor localization systems enables possibilities of supporting light shows with drones. MOJO Devices has developed a set of drones combined with a location service for a light show, supporting this year's DJ Bobo tournee.

Objective: The system is based on ultra-wideband (UWB) technology, operating in the two-way ranging mode. The capability of this localization scheme is limited to four positions per second per drone, with four drones. The goal of this thesis is to develop a new localization system with an increased accuracy (down to 10 cm), which supports many more drones.

Result: The designed system still operates with UWB pulses, but due to the time synchronization of the reference points (anchors), it additionally supports the Time Difference of Arrival (TDoA) and the Time of Arrival (ToA) schemes. To ensure precision of the timestamps, special attention is paid on introducing as little jitter as possible into the clock distribution network. Using TDoA with the developed message management protocol, at least 125 positions per second are possible. Furthermore, with ToA, thousands of drones are able to locate themselves over 40 times per second. All key parts, such as UWB communication, time synchronization and time stamping have been tested successfully.



Proposed UWB message management scheme for five drones, where each drone can be localized at least 25 times per second.
Own presentment



Overview of the entire localization system: All anchors are time synchronized by wire, whereas drones communicate over the IEEE 802.15.4-2011 UWB standard with the anchors.
Own presentment